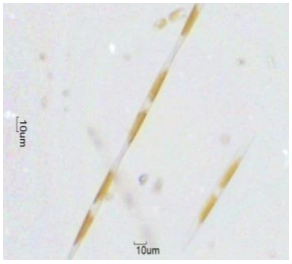
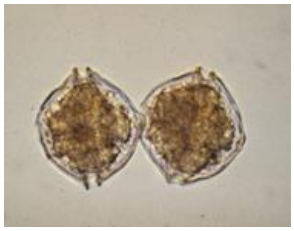
DMR Biotoxin Monitoring Guidance Document

This is a guidance document for industry and can change at the DMR's discretion



Pseudo-nitzschia spp.

domoic acid, ASP



Alexandrium sp.

saxitoxin, PSP

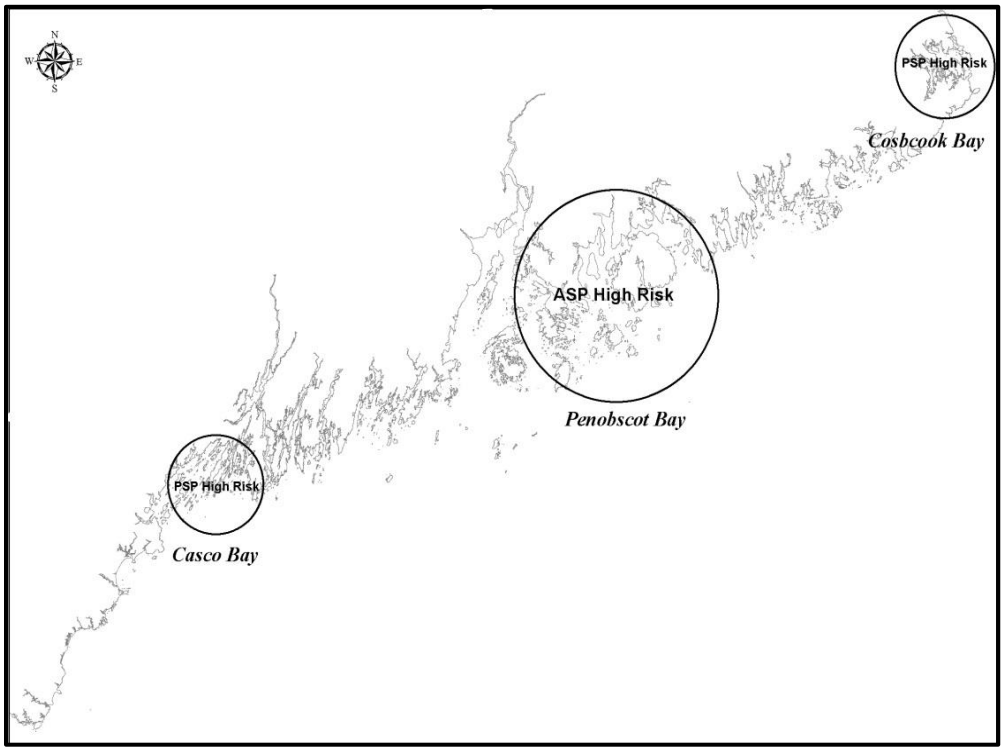


Figure 1. Maine high risk areas for PSP and ASP based on DMR historical shellfish data.

DMR began discussions in 2013 after changes to biotoxin management were initiated to better address high risk shellfish species and high risk areas. Considerations were given to shellfish with rapid uptake rates (mussel and scallop) and prolonged toxicity (surf clams and scallop) to better define a sampling strategy and memorandum of understanding (MOU) for these species cultivated by Aquaculturists. The MOUs provide a means for maximum flexibility to harvest product during regional biotoxin closures and throughout the year based on site location, species harvested, and testing frequency requirements. To effectively manage all biotoxin risk that can be specific to the shellfish aquaculture industry in Maine, DMR has identified areas of high biotoxin risk (Figure 1.) based on the type of toxin and specific management criteria for safe harvest (Figure 2.). Precautions will be implemented in high risk areas and in some cases may result in limitations on harvest or increased testing requirements. Using weekly, routine monitoring of mussel and clam sites as the baseline, additional testing required for aquaculture considered outside of DMR routine sampling practices will be paid by industry. This includes all scallop aquaculture testing. Wild harvest exception areas are closed when DMR routine sampling indicates an elevated risk, there is no opportunity for additional, industry funded sampling.

The degree to which shellfish become toxic is dependent on exposure to toxic phytoplankton cells in the water column and shellfish species filtration rates. Environmental variables can drive cell abundance increases in a short amount of time. Once cells begin to increase the unpredictable nature of blooms can result in shellfish toxicity above regulatory limits within as little as 24 hours. Monitoring the water column and the increase of shellfish toxicity requires a multi-layered, resource intensive strategy that

requires full cooperation with industry. Shellfish aquaculture poses the greatest challenge to monitoring during bloom events because it is normal practice to suspend product in the upper water column where exposure to phytoplankton cell abundance is greatest during the bloom season.

Casco Bay, Cobscook Bay are considered high risk areas for PSP toxicity based on historical DMR biotoxin data. These areas are exposed to chronic and highly variable toxic bloom scenarios caused by *Alexandrium fundyense*, the phytoplankton responsible for Paralytic Shellfish Poisoning (PSP). This chronic exposure time (24 hours a day) combined with high filtration rates and/or higher tolerance to *A. fundyense* exposure (see high risk species list) is conducive to rapid and unpredictable shellfish toxicity. For more information about *Alexandrium fundyense*, the toxin it produces or other related facts, go to: http://www.whoi.edu/redtide/human-health/paralytic-shellfish-poisoning.

Since 2012, annual blooms of another toxin producing phytoplankton called *Pseudo-nitzschia spp.* has occurred in the Penobscot and Frenchman's Bay region. The toxin produced by this phytoplankton, domoic acid, is responsible for causing amnesiac shellfish poisoning (ASP) because exposure can cause short and long term memory loss along with other serious health effects. Unlike other areas along the coast, shellfish testing in this region has tested positive for low levels of domoic acid during bloom periods from June-October. For this reason, we consider the Penobscot and Frenchman's Bay region a high risk area for ASP that requires intermittent testing (see high risk species list) during or after these bloom events. For more information about *Pseudo-nitzschia spp.*, the toxin it produces or other related facts, go to: http://www.whoi.edu/redtide/human-health/amnesic-shellfish-poisoning.

Managing High Risk Areas and Species

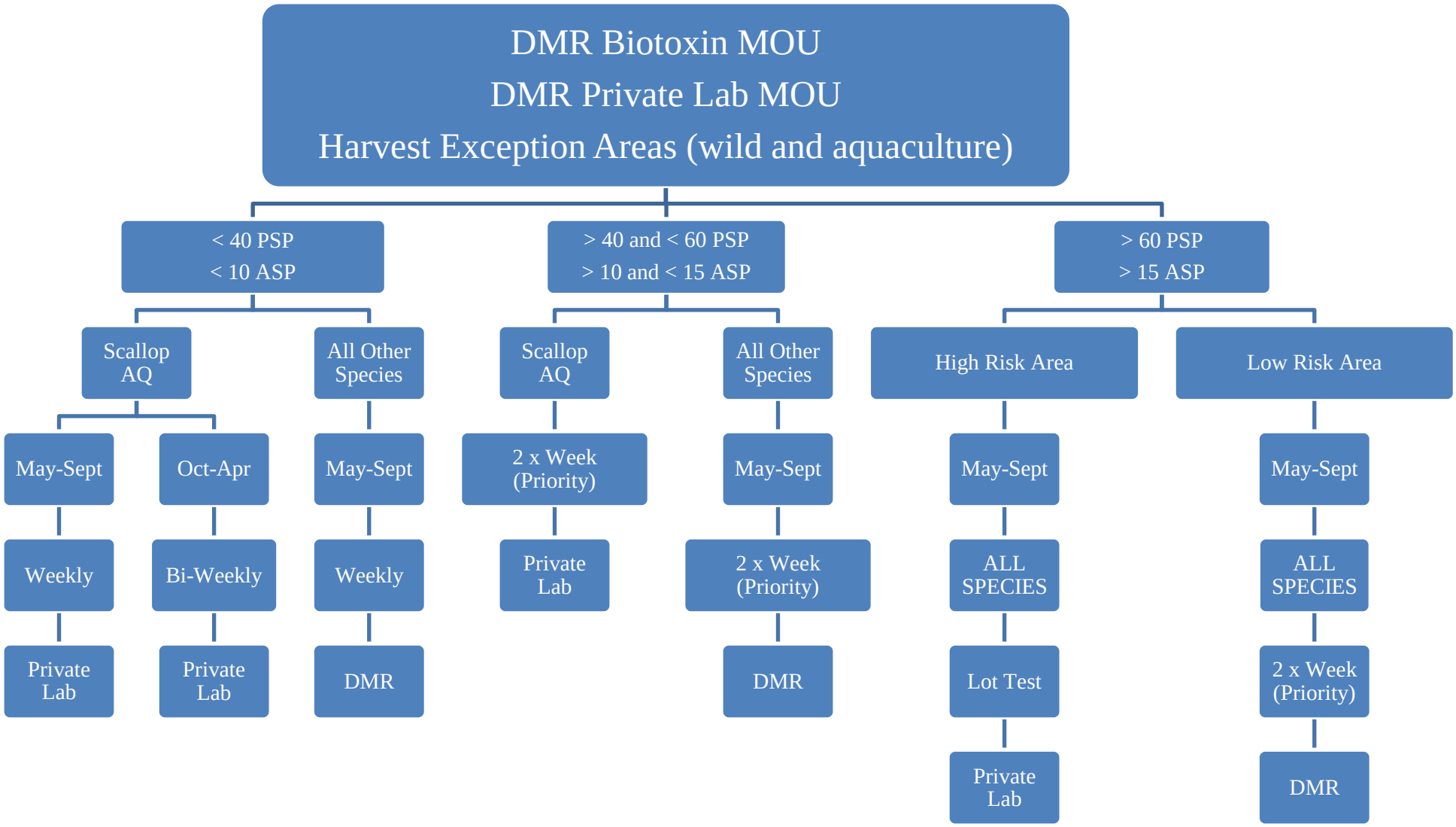
All areas along the coast during the bloom season (April-October) require regular (weekly) monitoring, however high risk areas and species will have additional considerations and therefore are managed differently. When toxin increases in high risk areas, high risk species (wild and aquaculture) will be managed more cautiously by the DMR because toxicity is unpredictable. During the bloom season when toxic phytoplankton is most abundant (May-September), regional biotoxin closure will occur and exception areas established to monitor this threat appropriately. Exception areas require industry who would like to harvest during this time to sign MOU's with the DMR to establish testing requirements (see DMR MOU). During any regional closures when exception areas are active, shellfish and water samples will be required from each lease site that has opted to sign an MOU. Based on historical data, toxicity can increase from below the regulatory limit to over the regulatory limit (>80ug STX) within the weekly sampling regime therefore toxicity "triggers" have been established that will direct increasing sample frequency and when lot testing is required to continue harvest through a private lab and paid for by industry (Figure 2.)

High Risk Species (wild and Aquaculture)

1. **Blue Mussel: *Mytilus edulis***
2. **Atlantic Scallop: *Placopecten magellanicus***
3. **European Oyster: *Ostrea edulis***
4. **Atlantic Surf (Hen) Clam: *Spisula soldissima***

Scallop Aquaculture: Scallop possess an additional biotoxin risk because they are slow to eliminate toxins (domoic acid and saxitoxin) due to their capacity to store these toxins within their tissues. Other species like mussel and softshell clam store toxin within their digestive glands thus remain toxic only while toxic phytoplankton are in the water columns and can depurate toxin once the bloom has passed. Scallop will store these toxins by metabolic processes to other tissues for long periods of time. During that time biotransformation from low potency to higher potency derivatives of these toxins across different tissues can occur. It is unknown how initial toxicity correlates with higher toxicity through biotransformation in scallops but can be further compounded by exposure to consecutive bloom events across seasons. For example, toxicity of scallop samples that reached a 200ug STX eq at a site during a bloom can become more toxic via biotransformation over the year only to be exposed again to another bloom event the following season. The residence time of toxicity in tissue is driven by species kinetics/metabolism but can also be compounded by environmental variables such as temperature and biological processes like spawning. Because high risk areas are prone to chronic exposure to toxin (annual bloom events) and higher toxicities than other areas, species like scallop grown in these areas require testing year round when phytoplankton blooms are no longer in the water (outside of the biotoxin season). Research suggests roe/gonads are the least impacted second to the adductor mussel (which does not become toxic) and can remain non-toxic at the same time other tissue exceeds regulatory limits. However until more data is available DMR cannot allow a roe-on fishery when testing indicates toxicity of the entire animal above the regulatory limit. Requirements for monitoring and testing by industry include:

- **Coordination Through Private Lab and Paid by Industry**
- **Annual renewal of Private Lab Testing MOU and DMR MOU**
- **Written notification prior to harvest (at least 3 weeks)**
- **2 samples 7 days apart to initiate harvest**
- **<40 ug STX AND <10 ug DA every two weeks (October-April)**
- **>40 ug STX OR >10 ug DA weekly (May-Sept)**
- **>60 ug STX OR >15 ug DA lot testing required**


DMR Biotoxin MOU
DMR Private Lab MOU
Harvest Exception Areas (wild and aquaculture)
< 40 PSP
< 10 ASP
> 40 and < 60 PSP
> 10 and < 15 ASP
> 60 PSP
> 15 ASP
Scallop AQ
All Other Species
Scallop AQ
All Other Species
High Risk Area
Low Risk Area
May-Sept
Oct-Apr
May-Sept
2 x Week (Priority)
May-Sept
May-Sept
ALL SPECIES
May-Sept
ALL SPECIES
Weekly
Bi-Weekly
Weekly
Private Lab
2 x Week (Priority)
Lot Test
2 x Week (Priority)
Private Lab
Private Lab
DMR
DMR
Private Lab
DMR